To constrain the forecast horizon of geomagnetic data assimilation, it is of interest to quantify the range of predictability of the geodynamo. This can be done using the “dynamical method” initially designed in meteorology, which relies on the numerical integration of twin solutions originating from slightly different initial conditions.

From a systematic investigation of the sensitivity of numerical dynamos to various instabilities, we show that the subsequent growth rate is independent of the type of perturbation, of the amplitude of perturbation, and of the field in which it occurs. Exploring various possible scaling laws, we demonstrate that this growth rate scales with an advection timescale, and is more precisely controlled by the magnetic dissipation timescale (which characterise the rate at which magnetic energy is produced to compensate for Ohmic dissipation in a saturated dynamo).

Extrapolating these results to the conditions believed to hold in the Earth's core, an error growth rate of 35 yr-1 is estimated for the geodynamo. Were the dynamo code assumed to be perfect and the initial state known at 10%, this could translate into a horizon of predictability of 80 yr.